ENGINEERING MAINTENANCE BRANCH BULLETIN

Issue # 011

THIS ISSUE CONTAINS:

This is *the* engineering maintenance management bulletin to MSC ships and shoreside personnel. The purpose of the bulletin is to inform all concerned of current COMSC Preventive Maintenance management practices associated with any new or revised policy and procedures, along with helpful tips & tricks for improved maintenance. The bulletin will also discuss and present any upcoming initiatives in the various programs.

We continue our efforts to bring you useful information with the page dedicated to the Vibration Monitoring System (VMS). This will have useful tips as well as past case histories.

PICTURE OF THE MONTH REQUEST - WE NEED *YOUR* PICTURES!!

It is said, **"A picture's worth a thousand words!"** If you have pictures of Shipboard Maintenance (Vibration Monitoring, Oil Sampling, machinery upkeep, etc.) being performed, or a visit from a SAMM or VMS Tech Rep, please send them (along with a *brief* narrative as to what the picture is about) to Norm Wolf (e-mail: Norman.wolf@navy.mil).

A shipyard worker and NSWC Port Hueneme Rep perform a weight test on the port Dry Cargo Rig aboard the USNS LEWIS & CLARK (T-AKE 1) at NASSCO Shipyard in San Diego, CA. Seaworthy Systems and MSC HQ personnel revisited the vessel to perform a follow-up visit of ship's equipment for SAMM Database development and discuss the installation schedule for SAMM and the Vibration Monitoring System (VMS).

SAMM/Maintenance Tips

Root Cause Analysis (RCA) Tip: Optimizing your Root Cause Analysis efforts means that we should not be content and rest on our laurels that we have succeeded in eliminating the risk of recurrence of an event. True RCA optimization involves Knowledge Management (KM) of the information used to solve the problem.

If other people in your organization are not made aware of your findings and conclusions, then they risk the same thing happening in their areas. RCA also involves putting such information at the fingertips of those that need it most!

-Tip provided by the Reliability Center Inc., http://www.reliability.com

Oil Analysis Tip: Whenever possible, the sample should be drawn while the unit is operating. If that is not possible, the sample should be drawn as soon after shutdown as possible. This assures that separation of any particles or water in the reservoir does not occur.

-Tip supplied by PdMA

DEXTER - Machinery Health Monitoring Software

By Liem Nguyen, Mech. Engineer & MACSEA

What is DEXTER?

DEXTER is software that automatically and continuously monitors, diagnoses and predicts machinery health on board many MSC ships. The primary applications to-date have been diesel and gas turbine engines, including their auxiliary subsystems.

Linked into the existing alarm and monitoring systems, DEXTER takes real-time performance data from the equipment and applies advanced statistical analysis to assess present and future health.

DEXTER is integrated into the Shipboard Automated Maintenance Management (SAMM) system to automatically input historical machinery performance data to other maintenance software systems.

How does it work?

Real-time data from the equipment is continuously compared to baseline device models to assess if it is deviating from normal and expected values. These baselines have been derived from historical operating data and are crucial in detecting abnormal equipment performance.

DEXTER classifies equipment performance deviations exceeding statistically defined limits as alarm conditions. These alarms are then fed into an analytical diagnostic/prognostic process that associates these alarm symptoms with the possible faults that may have generated them.

Relationships between possible equipment faults and their symptoms are stored in knowledgebases, essentially databases of theoretical and practical expertise. DEXTER uses knowledgebases as the essence of its artificial intelligence, continually analyzing fault conditions through neural network processing technologies to provide automated diagnostics and prognostics, detecting even the subtlest trends.

User Alerts are generated that highlight the individual faults together with associated probabilities based upon the symptoms that DEXTER has detected. These alerts give the crew member actionable information regarding evolving machinery problems. He can then investigate any alert in more depth through DEXTER's drill-down capabilities into current and past performance.

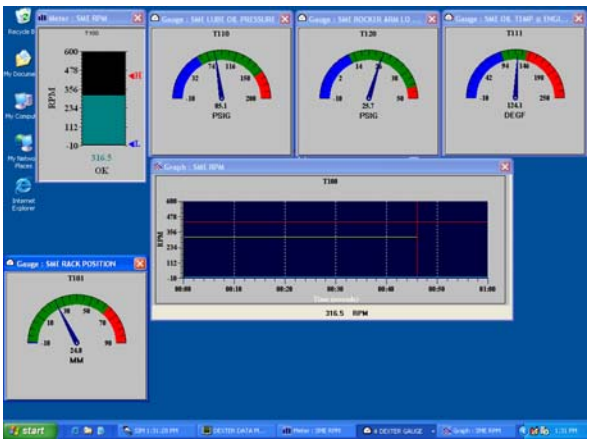
Alarms and Alerts

DEXTER automatically analyzes large amounts of data and provides continuous checking of equipment health. It detects very subtle performance deviations over time and predicts likely equipment problems at their earliest stages of development. Alerts generated by DEXTER can provide forewarning of potential equipment problems, alerting the crew long before alarms are generated by traditional alarm and monitoring systems found aboard ships.

Features

DEXTER Version 4.0 has several main machinery monitoring functions that include:

- *Data acquisition and historical archiving*: Automatically acquires engine performance data through digital interfaces with existing monitoring systems. It reduces manual data logging dramatically.
- *Equipment Health Displays:* Delivers real-time and historical views of equipment health to the crew, no matter where they are located. Easy to read software gauges provide a familiar presentation that allows any monitored data point to be quickly interrogated. The software also allows easy creation of custom data displays, such as mimic diagrams, which clearly show key system conditions in real-time.



- A*larm monitoring*: Detects subtle changes in performance when any monitored engine parameter exceeds the specified limits.
- *Performance analysis*: Compares measurements taken from the equipment sensors to an established reference baseline or "knowledgebase," while continually tracking and reporting deviations to the equipment.

- *Trending analysis*: Continuously monitors the equipment and through a regression analysis capability, is able to detect any trends due to changing equipment performance and extrapolates this information to provide you with adequate warning of upcoming maintenance actions.
- *Fault diagnostics*: Reports any faults it has diagnosed with your equipment that exceed the specified probability thresholds.
- *Fault prognostics*: Analyzes significant trends in equipment performance and extrapolates them into the future to predict when the fault will actually occur.

How can DEXTER be a valuable CBM tool?

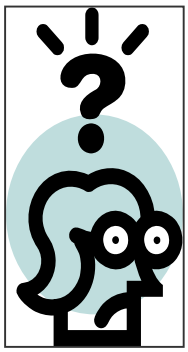
The purpose of DEXTER is to automate the data reduction and analysis work required to implement a Condition-Based Maintenance (CBM) strategy across the fleet of MSC ships. The CBM approach involves monitoring for changes in machinery operating performance. This follows a model-based diagnostic approach, whereby baseline models of engine performance are continuously compared to actual performance. When actual engine performance deviates from the model (expected) behavior beyond reasonable statistical limits, DEXTER issues an alert to the crew. DEXTER will also try to make sense out all such alerts that it detects based on an embedded "knowledgebase" of faults developed with the help of the engine manufacturer, as well as other engine "experts". This knowledgebase relates faults and alert conditions expected to occur when the fault is present.

The analytics within DEXTER are fairly complex and would require a lot of time and special engineering and statistical skills for one of the crew to perform them. No one has time to do this on a consistent and reliable basis, yet in order to realize the benefits of CBM, this work must be accomplished. DEXTER does this work for the crew and provides actionable information to head off problems, not just raw data that sometimes is difficult to comprehend. DEXTER will mine engine performance data and tell you when it "thinks" something is wrong or may go wrong in the future. DEXTER is your analytical software agent designed to do diagnostic work for you, from automatically acquiring the data from the automation to assessing machinery performance changes.

Key benefits:

- **Consistent and reliable equipment health monitoring**
  - The analysis procedures can be as analytically complex as necessary
  - Expert diagnostic knowledge is embedded into DEXTER and can be distributed across the fleet for a consistent, repeatable, scientific analysis of engine health, no matter what crew is aboard
  - Because it's all automatic, there's no additional crew workload
  - Historical diagnostic alert information is recorded for further review when it's time to make informed maintenance decisions
  - DEXTER works 24/7, reliably and continuously
- **Transforms raw data into meaningful, actionable information.**
  - DEXTER is a tool to be used by the crew
  - It can monitor hundreds or thousands of data points
  - It will correlate, assimilate, and make sense out of very subtle performance changes, that often remain hidden in the volumes of data
  - DEXTER will direct you to detected problems that can then be investigated in more detail
  - DEXTER can help avoid large, expensive problems by alerting the crew at the earliest possible stage

Between now and Sept. 2006, MSC in cooperation with MACSEA Ltd. will be upgrading DEXTER version 4.0 to the following ships: The WATSON Class, the T-AOE Class, the USNS PATHFINDER, the USNS SUMNER, and the T-AO (KAISER) Class (except USNS KAISER, USNS HUMPHREYS, USNS LENTHALL, USNS GRUMMAN). DEXTER training will be provided upon installation and during the quarterly CMEO training in Athens, Georgia. For further information or questions, please contact Liem Nguyen (liem.nguyen@navy.mil) at 202-685-5969.



Question of the Month:

What is Condition-Based Maintenance (CBM), and why it is important to implement CBM in order to maximize plant effectiveness?

(By Liem Nguyen)

In today's competitive environment, being able to optimize your plant assets is a key element of how you are able to respond to the changing demands of operations. In order to be able to meet these demands, it is important that your plant assets are available when they are needed. Condition Based Maintenance (CBM) is a broad name for evaluating maintenance requirements based on a specific performance indicator or specific measurement and can help to provide you with the "Asset Health Information" you need to be able to manage your plant.

Utilizing a CBM program will help to minimize the maintenance actions on equipment or systems without sacrificing its integrity or reliability. The effectiveness of a CBM is dependent upon a number of factors:

Implementation

It is important to understand why plant assets fail. Therefore the asset or equipment failure mode must be defined. Failure modes can be defined from operational history, industry knowledge, or the equipment/system manufacturer.

Once the failure mode has been established the method by which it can be detected must be selected, common CBM methods include:

- Vibration Analysis
- Thermography
- Oil Analysis
- Ultrasonic Testing
- Routine Inspections
- Magnetic Particle Testing
- Electrical Tests (Megger readings, etc.)

Monitoring

It is important to establish which assets are to be part of the Condition Based Maintenance program, their criticality, which in turn will determine the method of monitoring, and the machine data collection intervals.

Analysis

Once the data has been collected it is vital to the success of the CBM program that experienced professionals analyze this data in a timely manner to ensure that any changes may be reviewed, reported and acted upon.

When implemented correctly, a CBM program will help lower maintenance costs, increase machine availability and reliability, improve safety, enhance product quality, and in many cases, extend the life of the equipment.

For more information, or if you have any questions/comments, contact Will Carroll (William.s.carroll@navy.mil) or Norm Wolf (Norman.wolf@navy.mil).

Engineering Maintenance Branch Website – something old is new again!!

The Engineering Maintenance Branch web page continues to get a bit of a facelift; along with some helpful downloads (SAMM, PENG, EASy overviews, OAS Guide, ***past issues of our bulletin!***, etc.), the latest CMEO Class information and who to contact for questions or comments regarding Engineering. Maintenance. For helpful updates, keep checking it out!

http://www.msc.navy.mil/n7/engmgmt/engmgmt.htm

ENGINEERING MAINTENANCE BRANCH BULLETIN

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(cut it out & keep it handy!)

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Mechanical Engineers – Liem Nguyen, (202) 685-5969 (liem.nguyen@navy.mil) & Andrew Shaw, (202) 685-5721 (andrew.shaw@navy.mil);

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CMEO Training – What Are YOU Waiting For????

CMEO (**C**IVILIAN **M**ARINE **E**NGINEERING **O**FFICER) is a two-week training course (held *quarterly*) at the Naval Supply Corps School in Athens, GA. It is for both shipboard and shoreside engineers. The Engineering Directorate (Code N7) of Military Sealift Command hosts the course and encourages ***ALL*** MSC Engineers (3rd A/Es through Chief Engineers, as well as Port Engineers and Project Engineers) to attend *(**Note:** MSC shipboard engineers are given priority when classes are full).*

CMEO provides training on an array of topics such as: SAMM (Condition Monitoring, Maintenance Scheduling and Repair, Diesel Engine Analysis, Logbook, etc.), Vibration Monitoring, Lube Oil, Fuel Oil (NEURS), Chemicals (boiler treatment, sewage treatment, etc.), Supply (COSAL, ShipCLIP), Environmental, and Safety. SAMM is interactively taught using actual data and each module is discussed extensively.

Upcoming CY '06 class dates:

- July 10-21, 2006
- December 04-15, 2006

For further information and to sign up, please go to the CMEO website:

http://63.219.124.12/cmeoclasssignup/cmeo.htm

Or contact Dave Greer (david.greer1@navy.mil) with any questions.

THE FORECAST FOR TODAY IS… FEEDBACK!

With each issue, we get more and more requests for the newsletters, from both shoreside AND shipboard engineers, so we know you're reading them. Now, tell us what you think and what you want to see! Feedback is *ESSENTIAL* to making this a helpful bulletin to all shipboard personnel in doing your job "smarter not harder". Please pass on ***any and all*** feedback from your Engine Department personnel.

Not just another piece of Junk mail

JUNK MAIL: You don't want it; we don't want to create it. Make this ***YOUR*** Maintenance Management Bulletin. If there's a SAMM or Maintenance tip, topic, question, suggestion, or comment on how to make this useful, or something relating to Engineering Maintenance you think should get out to the ships, please pass it on. Send your submission to Randy Torfin (randel.torfin@navy.mil) *OR* Norm Wolf (norman.wolf@navy.mil).

COMING UP FOR *NEXT ISSUE*!

New SAMM/Maintenance Tips!

Another Question of the Month

More Maintenance Management Issues

A New Picture of the Month!

Vibration Monitoring Tips & Information

A Case Study: Reciprocating Air Compressor

by DLI Engineering

A reciprocating air compressor on a Navy cruiser began to make a knocking noise shortly after the start of post-overhaul sea trials. The compressor had been routinely overhauled, and had passed vibration acceptance testing during Engine Room steaming.

Regardless, the knocking noise was readily audible over the noise of the compressor and the engine room. As I was installing accelerometer-mounting blocks on the compressor, I noticed that the noise was intermittent, coming in and going out on a somewhat regular basis. After the adhesive had set up, I attached the accelerometers to the mounting blocks, and adjusted the levels on the tape recorder we were using for data acquisition. I expected to reduce the recording level when I saw the effect of the knocking noise.

When the knock started again, and the meters on the tape recorder did not change their position, I was surprised. The noise was clearly audible over the compressor operating noise, but it made no difference in vibration levels on the compressor bearings. This was puzzling, as the noise seemed to come from the compressor. Some change in vibration levels on the bearing caps should occur with the knocking.

I moved the accelerometers to the motor. The vibration levels on the motor also remained steady regardless of whether the knocking noise was present or not. I stood next to the compressor and watched the recorder levels, still not recording any vibration data, no change whatsoever. I timed the period between knocking bursts. They were almost regular, but not quite constant.

As I was contemplating the situation, I noticed the roll of the ship. That's interesting. The knocking occurs only when the ship rolls to port. On an even keel, or on a starboard roll, there is nothing.

Since the noise seemed to come from the compressor crankcase, I got down on my hands and knees next to the crankcase. Hmm… the noise isn't coming from the crankcase, but from below the crankcase. A flashlight, and another moment of observation finally revealed the problem: a bolt in one of the isolation mounts was too long, causing it to rattle against the isolated foundation each time the ship rolled port. It was a problem solved by merely hack sawing off the excess length.

No amount of vibration data recorded from the motor and compressor bearing caps would have helped to solve this particular problem. Careful observation of the condition and surroundings resulted in a quick simple fix on what otherwise might have meant a costly tear down of the unit.

A Sticky Subject: Adhesives for Mounting Pads to Machines

By Mike Johnson, DLI Engineering

Within the MSC VMS Program we connect a tri-axial accelerometer cluster to a bronze, disk-mounting pad to measure vibration on rotating machinery. The accelerometers actually measure the bearing housing response to vibrations that are internally excited from within the machine. The purpose of the mounting pads is to ensure repeatability of the measurements from test to test. Each ship has a supply of pads and Loctite Speedbonder #325 adhesive with Loctite Activator #7380. The bond between the pad and bearing housing must be strong enough to transmit vibration from the bearing housing to the accelerometer without excessive damping.

There are a number of qualities we seek in a good adhesive. Since it is mainly used for attaching the attachment pads, we look primarily for a high modulus of elasticity (resistance to stretching). Clearly, we want to accurately transmit vibration to the accelerometer. Like a sponge, an adhesive with low modulus activity may absorb necessary high frequency vibration. Another desirable attribute is a short bonding period. This is in order to reduce the possibility of changes in the pad's position due to either machinery vibration or a wayward elbow. Resistance to oils, solvents, salt water, and heat are also important, especially in an environment where all are prevalent. Lastly, an adhesive shouldn't pollute the environment unduly, and must be readily obtainable. The Loctite product (adhesive and activator) mentioned above meet all these criteria.

While we're on the subject of adhesives and attachment pads, here are a few reminders about blocking procedures. Refer first to the Vibration Test Analysis Guide (VTAG) to determine where to make vibration measurements for specific machine types. Placement of test points on flexible or light metal structures will give inconsistent data. Place each test point on or as close as possible to the bearing cap because vibration is transmitted from the rotating shaft through the bearing to the bearing housing then to the test pad and eventually into the accelerometers. Because it establishes a short and solid transmission path, the bearing cap provides the best data quality and diagnostic accuracy. To further enhance the transmission path, keep in mind when fastening the pads that the plane of adhesive should ideally be as thin as possible in order to emulate metal-to-metal contact. Both the adhesive and activator have a shelf life of 2 years from manufacture and one year from the time you open the product.

For more information, or if you have any questions, you can reach DLI by Phone (206-842-7656), or E-Mail (bhoyson@dliengineering.com or mjohnson@dliengineering.com).